

Title: Solving real world problems involving units of measurement		
Grade: HS		
PA Core Standard: CC.2.1.HS.F.4 Use units as a way to understand problems and to guide the solution of multi-step problems		
PA Connector:		Solve real world problems involving units of measurement
Strand: Measurement, Data and Probability		Family: Problem Solving Using Measurement Processes
Progress Indicator: <i>H.ME.1a Making decisions about units and scales that are appropriate for problem-solving situations within or across mathematics disciplines or real-world contexts</i>		
Big Idea(s): Mathematical relations and functions can be modeled through multiple representations and analyzed to raise and answer questions Mathematical relationships among numbers can be represented, compared, and communicated.		
Essential Question(s): How can data be organized and represented to provide insight into the relationship between quantities? How is mathematics used to quantify, compare, represent, and model numbers? How can mathematics support effective communication?		
Foundational Knowledge: <ul style="list-style-type: none"> Determine what units are used in problem (e.g., money, time, units of measurement, etc.). Determine the vocabulary for combining (e.g., in all; altogether) and decomposing (e.g., have left; take away, difference) in a word problem. Apply conversions of units while solving problems (e.g., Recognize that monetary units can be combined to equal other monetary units). Translate wording into various representations which could include numeric equation (e.g. formulas for area and perimeter). 		
Key Vocabulary, Concepts and Symbols: <ul style="list-style-type: none"> Relevant, non-relevant, equation, formula, measurement, square, cubic, linear. units of measurement, vocabulary used within the context of the problem 		
Suggested Instructional Strategies: <ul style="list-style-type: none"> Task analysis <ul style="list-style-type: none"> Understand the problem (recognize given information, remove any extraneous information, know what the question is asking) Plan (how to solve) Solve Check (answer the question) Model-Lead-Test * Problem Solving Least-to-Most prompts* <ul style="list-style-type: none"> Create relevant, story-based problems. Use graphic organizers to provide students a means for organizing their work. Break down and isolate each step in solving the math task. 		

Supports and Scaffolds Considerations:

- Meaningful manipulatives
- Authentic materials (e. g. real coins, rulers)
- Number line
- Software that counts, or other means of hand tallying
- Graph paper where each square equals a unit
- Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)

Key Word Search:

measurement, problem solving

DRAFT

Title: Solving a linear equation to find a missing attribute given the area, surface area, or volume and the other attribute		
Grade: HS		
PA Core Standard: CC.2.2.HS.D.8 Apply inverse operations to solve equations or formulas for a given variable		
PA Connector:		Solve a linear equation to find a missing attribute given the area, surface area, or volume and the other attribute
Strand: Measurement, Data and Probability		Family: Perimeter, Area, and Volume Problems
Progress Indicator H.ME.1b Investigating the results when linear dimensions of objects change by some factor (e.g., area and volume change disproportionately: area in proportion to the square of the factor and volume in proportion to its cube)		
Big Idea(s): Mathematical relations and functions can be modeled through multiple representations and analyzed to raise and answer questions Mathematical relationships among numbers can be represented, compared, and communicated.		
Essential Question(s): How can data be organized and represented to provide insight into the relationship between quantities? How is mathematics used to quantify, compare, represent, and model numbers?		
Foundational Knowledge: <ul style="list-style-type: none"> Identify the unknown quantity when given an equation and labeled figure. (E.g., Provide a labeled prism and the formula $V = l \cdot w \cdot h$. Ask the student to draw/indicate the label on the prism to the letter in the equation.) Use inverse operations to isolate a variable. (e.g. use division to undo the multiplication of length by width and height in the formula $V = l \cdot w \cdot h$ to isolate length: $l = \frac{V}{wh}$) Given a picture, identify dimensions needed to calculate surface area, area, and volume. Understand what the variables in the formula(s) represent (e.g., h represents height, V represents the volume, etc.). 		
Key Vocabulary, Concepts and Symbols: <ul style="list-style-type: none"> Understand the following concepts and vocabulary: area, surface area, volume, width, length, height 		

Suggested Instructional Strategies:

- Use tiling to model the relationship between area and the dimensions.
- Use cubes to model the relationship between volume and the dimensions.
- When working with the area of a rectangle, calculate the area given the dimensions. Use the same area and dimensions to explore finding a missing dimension. Follow up by examining additional possibilities for the dimension given the same area. Model the area with tiles while discussing the dimension.
 - “What is the area of a rectangle that has a length of 6 and a width of 2?”
 - “If the area of a rectangle is 12 and the width is 2, what is the length?”
 - “If the area of the rectangle is 12 and the width is 6, what is the length?”
 - “If the area of the rectangle is 12 and the width was 4, what is the length?”
 - Continue with other possible dimensions of a rectangle that has an area of 12.
 - **Make explicit connections between these situations and the operations used with the formula.**
 - Choose a new value for the area, and repeat the process.
- Task analysis with Least Intrusive Prompts
- Provide a labeled prism and the equation $V = l \cdot w \cdot h$. Ask the student to draw/indicate the label on the prism to the letter in the equation. Break down and isolate each step in solving the math task.
- Provide nets to be taken apart (unfolding) to illustrate three-dimensional objects. Using two different nets with the same volume, but different dimensions can be used to make connections to the formula.

Supports and Scaffolds Considerations:

- Use foam letters for students to construct and manipulate the formula, as well as match up the letters to the dimensions on a figure.
- Assistive Technology (e.g., interactive whiteboard or other software, calculator, communication device)
- Manipulatives (2-D & 3-D shapes, tiles, foam letters)
- Counters (e.g., tally counter) and counting mechanism (e.g., number line)

Key Word Search: volume, area, surface area, prism

Title: Creating or selecting a graph (dot plots, histograms, or box plots) given a data set		
Grade: HS		
PA Core Standard: CC.2.4.HS.B.1 Summarize, represent, and interpret data on a single count or measurement variable		
PA Connector:		Create or select a graph (dot plots, histograms, or box plots) given a data set
Strand: Measurement, Data and Probability	Family: Represent and Interpret Data	
Progress Indicator: <i>H.DPS.1b Representing data with plots on the real number line (dot plots, histograms, box plots)</i>		
Big Idea(s): Data can be modeled and used to make inferences. Mathematical relationships among numbers can be represented, compared, and communicated.		
Essential Question(s): How does the type of data influence the choice of display? How can mathematics support effective communication?		
Foundational Knowledge: <ul style="list-style-type: none">Match the source of the independent values (i.e. at the bottom of the x-axis) with the appropriate category of the related data table.Describe the elements within a graph (e.g., in a box plot, the line is the median, the line extending from each box is the lower and upper extreme, and the box shows the lower quartile and the upper quartile).Complete the steps of a task analysis to complete a graph. (e.g. box plot)		
Key Vocabulary, Concepts and Symbols: <ul style="list-style-type: none">Understand the following concepts and vocabulary: quartile, median, intervals, upper and lower extremes, box plot, histograms, dot plots, value, independent value, vocabulary used within the context of the problem		
Suggested Instructional Strategies: <ul style="list-style-type: none">Follow steps of task analysis to complete box plot, dot plots, or histograms (these can also be found on internet or many calculators). Here is a sample task analysis:<ul style="list-style-type: none">Gather dataOrganize the data in numerical orderFind the medianFind the upper and lower quartilesDraw a plot lineMark your median and quartilesMark your outliersConnect your outliers to the box with a line (whiskers)Model-Lead-Test* using a data set and multiple graph representations		

Supports and Scaffolds Considerations:

- Technology (e.g., computers)
 - Drawing and graphing software
 - Virtual manipulatives <http://nlvm.usu.edu>
- Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)
- Graphing calculators
- Self-monitoring task analysis for student independence
- Tactile graphics

Key Word Search:

quartile, median, intervals, upper and lower extremes, box plot, histograms, dot plots, statistics, data analysis, graph

Title: Using descriptive statistics; range, median, mode, mean, or outliers to describe the data set		
Grade: HS		
PA Core Standard: CC.2.4.HS.B.1 Summarize, represent, and interpret data on a single count or measurement variable		
PA Connector:		Use descriptive statistics; range, median, mode, mean, or outliers to describe the data set
Strand: Measurement, Data and Probability		Family: Represent and Interpret Data
Progress Indicator: <i>H.DPS.1c Analyzing and summarizing the data resulting from studies using statistical measures appropriate to shape of the data (median, mean) and spread (interquartile range, standard deviation), and using data to support inferences (population parameters, sample size) or explain possible outliers</i>		
Big Idea(s): Patterns exhibit relationships that can be extended, described, and generalized. Mathematical relations and functions can be modeled through multiple representations and analyzed to raise and answer questions		
Essential Question(s): How can patterns be used to describe relationships in mathematical situations? How can data be organized and represented to provide insight into the relationship between quantities?		
Foundational Knowledge: <ul style="list-style-type: none"> Given a scatter plot, identify outliers in the data set. Identify the highest and lowest value in a data set given a number line and matching symbols (concept of range). Identify the concept of mode. Identify the concept of median. Find the mean. Identify the mode and the spread of the data using a line drawing of the distribution. Order data set using numeric symbols. 		
Key Vocabulary, Concepts and Symbols: <ul style="list-style-type: none"> Understand the following concepts and vocabulary: median, mode, mean, outliers, range, data set 		

Suggested Instructional Strategies:

- Task analysis: Example of task analysis for finding median
 - create a bar graph with an odd number of bars using snap cubes
 - arrange from shortest to tallest
 - have student place fingers on two outside towers
 - knock towers over and move inward until they reach the one middle tower left standing
- Calculate the mean using pre-slugged template of data points.
- Explicit vocabulary instruction for outliers
 - Find the median
 - Find the upper and lower quartiles
 - Mark your median and quartiles
 - Mark your outliers
 - Connect your outliers to the box with a line (whiskers)
- Multiple exemplars for outliers*
- Model data descriptions
 - Use concrete materials to find the mean (leveled plastic snap cubes: using the same bar graph with snap cubes, re-arrange cubes into equal stacks).

Supports and Scaffolds Considerations:

- Template for finding mean
- Use concrete representations of data
 - Use plastic snap cubes to represent the tally showing the number of occurrences
 - Create a bar graph with an odd number of bars using snap cubes
- Assistive Technology (e.g., interactive whiteboard or other software, calculator , communication device)
 - Virtual manipulatives
- Provide a graph of the data set
- Templates with sentence starters
- Manipulatives

Key Word Search:

median, mode, mean, outliers, range, data set, statistics, data analysis